

LABORATORY OF FOOD MICROBIOLOGY AND BIOTECHNOLOGY

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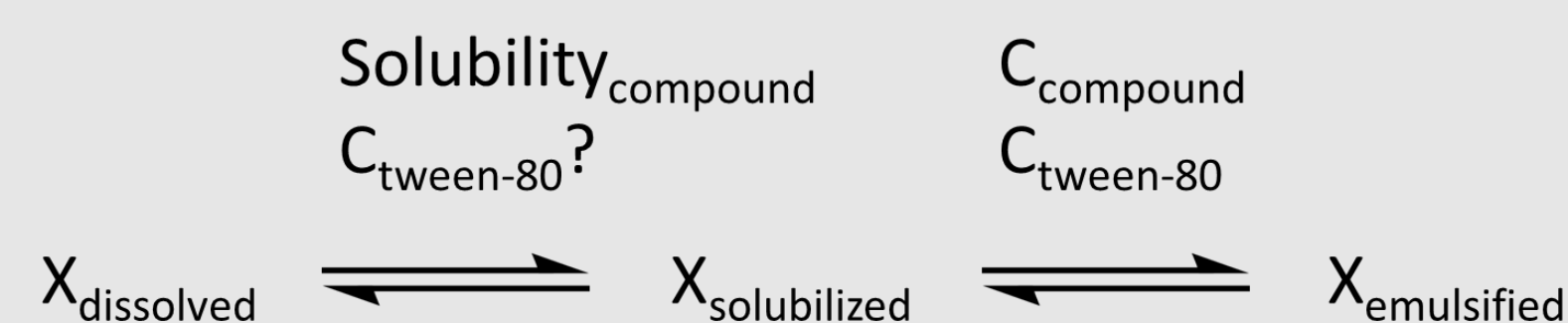
EMULSION CHARACTERISTICS EXPLAINING THE EFFECT OF TWEEN-80 ON THE ANTIMICROBIAL ACTIVITY OF ESSENTIAL OIL COMPOUNDS

Introduction

Essential oils (EO) have a low solubility in water (Wishart et al., 2013). Therefore, emulsifiers are needed to apply EO as antimicrobials in the food industry, as a lot of food matrices that are prone to microbial spoilage and contamination have a high water activity. Tween-80 is often used for this purpose because it is a well-known and food-grade emulsifier. However, Tween-80 can influence the antimicrobial activity of EO compounds (Van de Vel et al., 2017). Different hypotheses have been formulated about the mechanism behind this interaction (Van de Vel et al., 2017). To our knowledge, these hypotheses have not been confirmed yet. We investigated the characteristics of emulsions of individual EO compounds with different Tween-80 concentrations to link them to their antimicrobial activity.

Tested hypotheses:

- H1:** The antimicrobial activity of EO compound emulsions is linked to its droplet size.
- H2:** The antimicrobial activity of EO compound emulsions is linked to the dissolved concentration of the compound.



Droplet size of EO emulsions (H1)

Set-up:

Mixture preparation

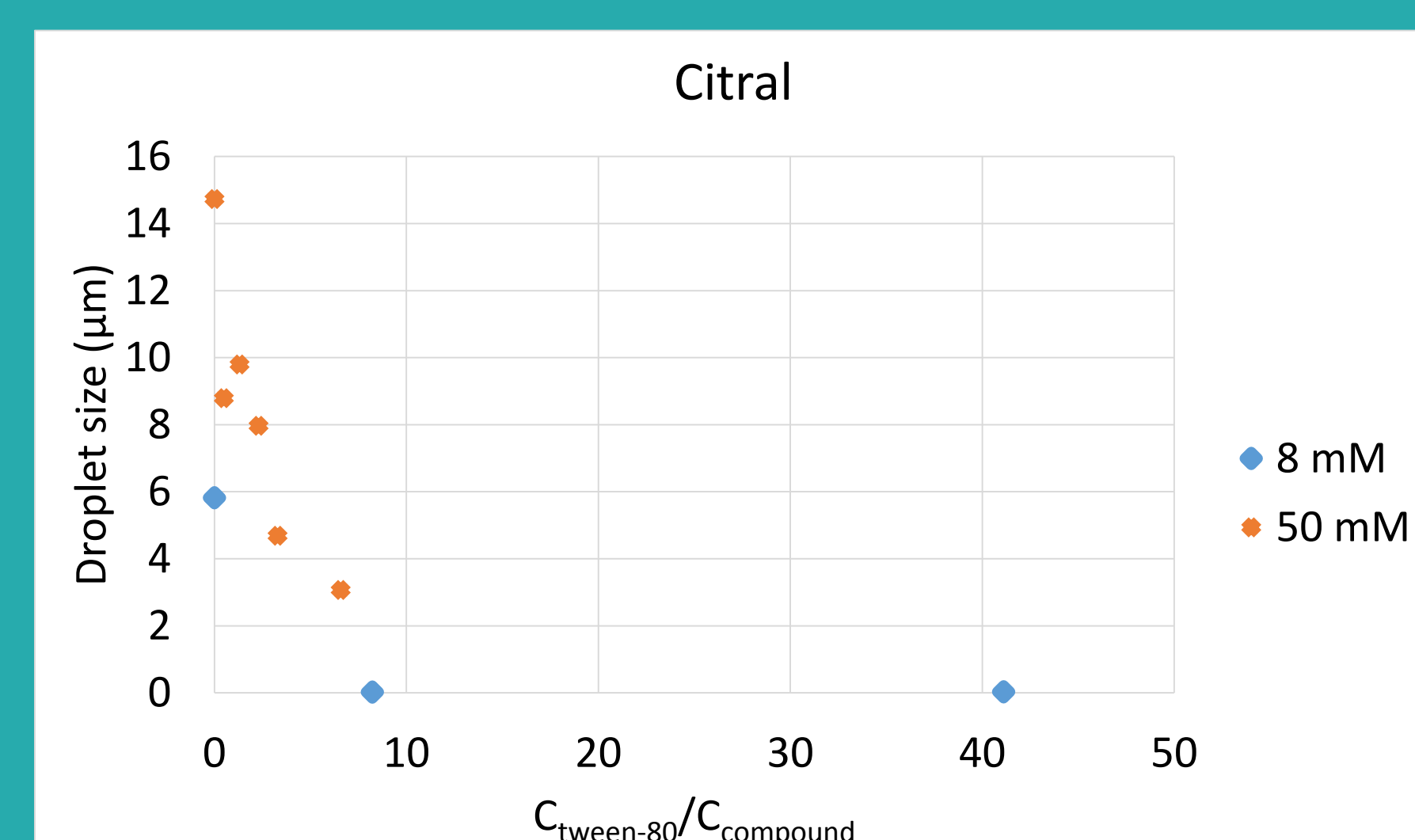
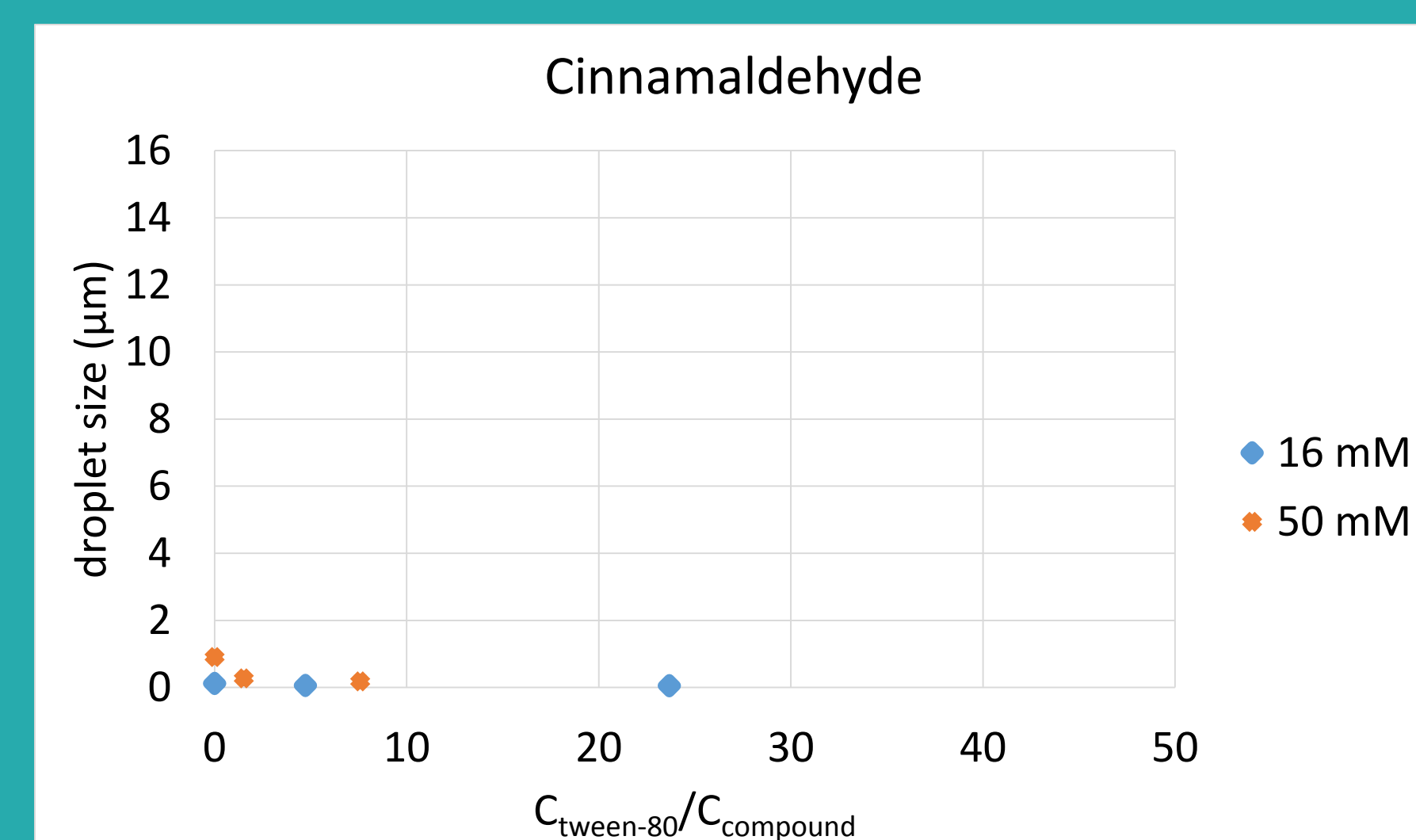
1' vortex (max. speed)

Pre-homogenization
(min. 1h magnetic stirrer (slow))

Measurement
(Mastersizer 3000)



Results:



Influence of Tween-80 concentration on antimicrobial activity of individual EO compounds

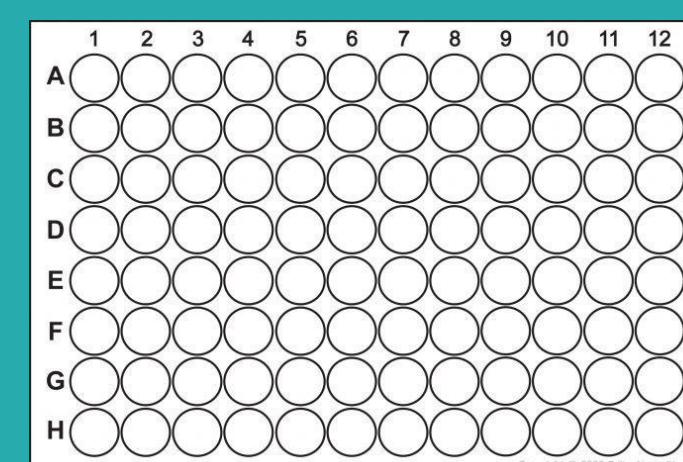
EO compounds:

Cinnamaldehyde
Citral
Eucalyptol*
Eugenol*
Geraniol*

Set-up:

5×10^5 CFU/mL (3 independent inocula):

- E. coli* LMG2093
- E. coli* JG33
- E. coli* JG45
- S. aureus* LMG8224
- S. aureus* TIAC39
- S. aureus* TIAC82



BHI + 0 – 5% Tween-80

MIC of EO compound

Blank = 0 mM EO compound, inoculated

Incubation:

0, 6, 12, 24 h

37°C

Shaking (5 Hz, amplitude 15 mm)

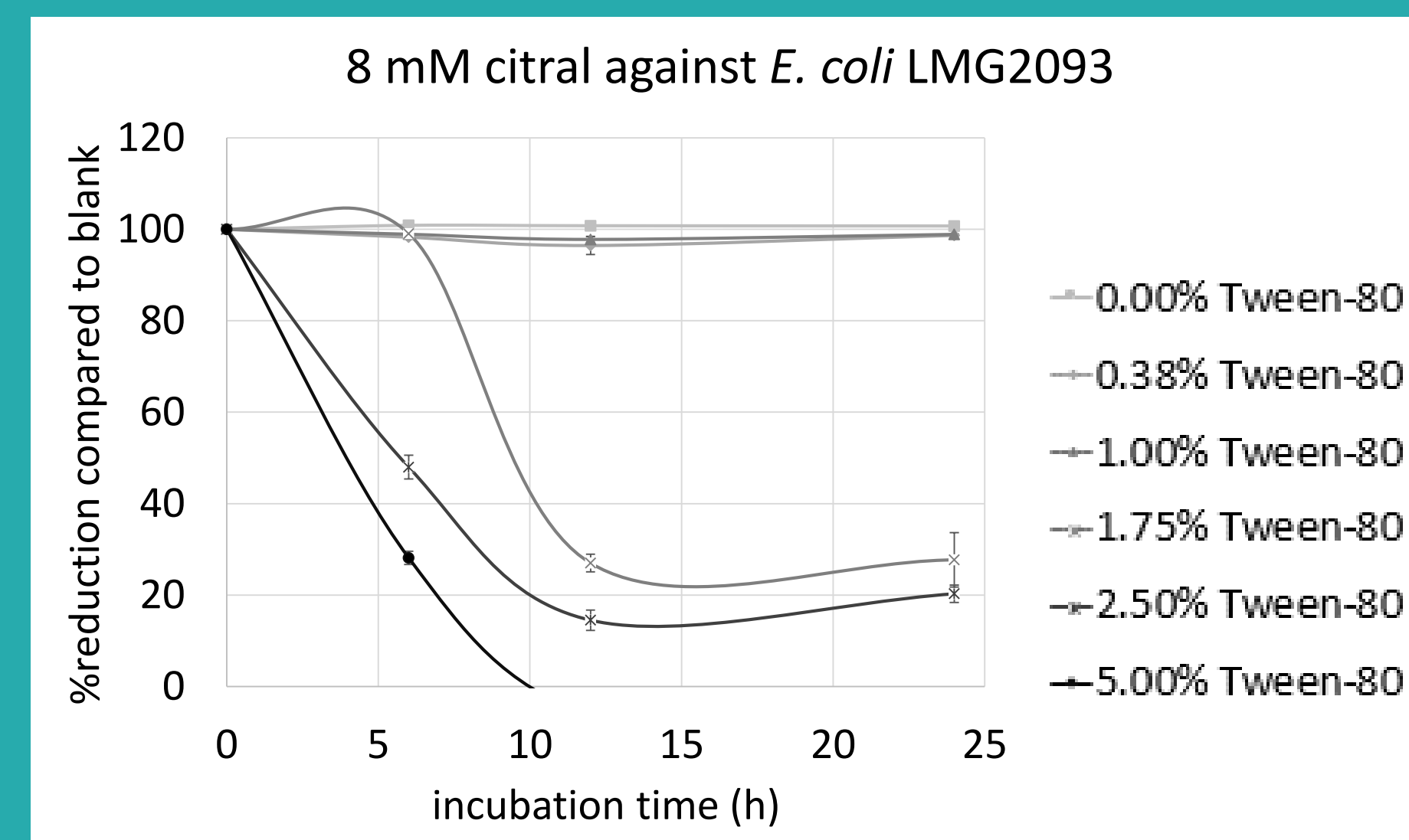
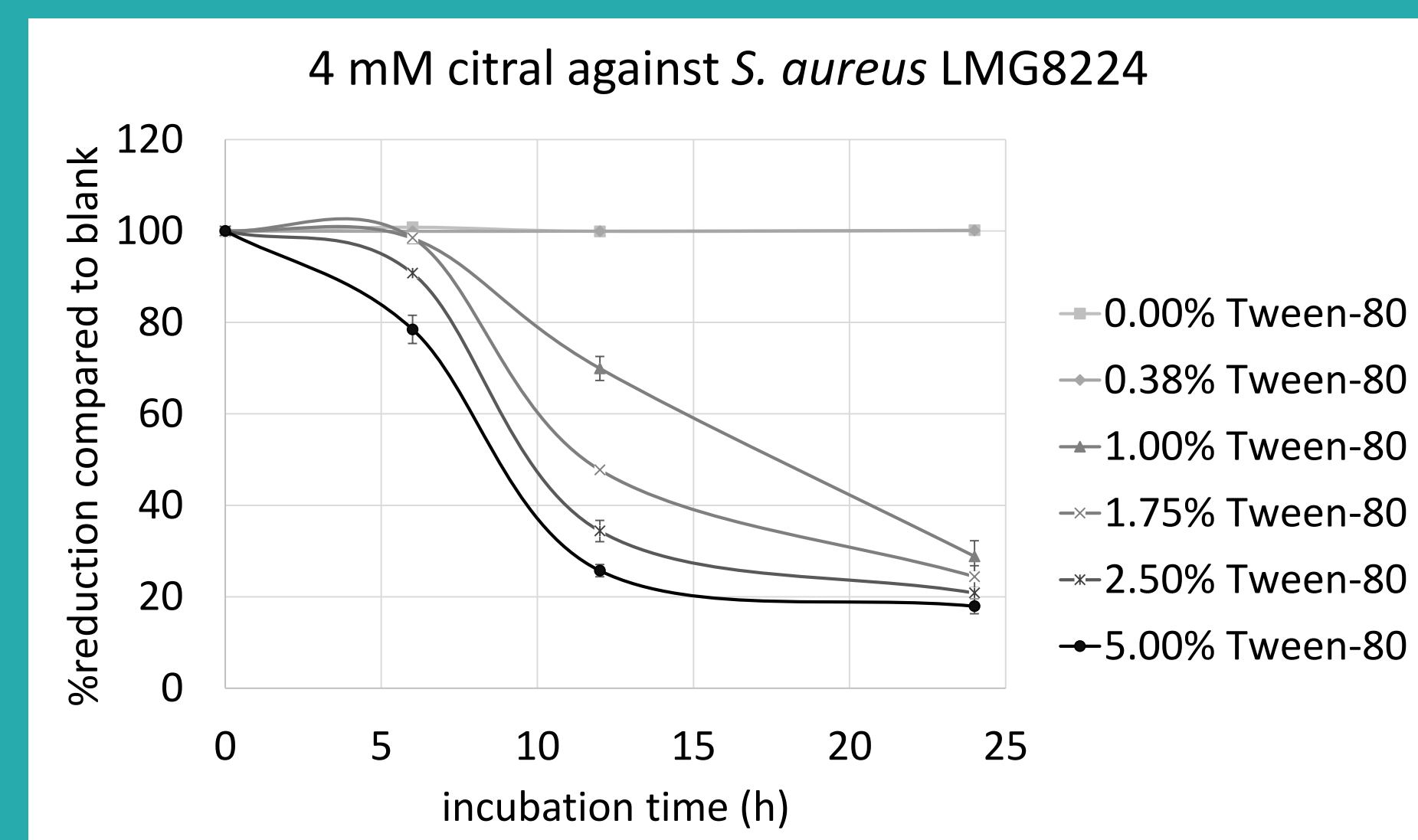
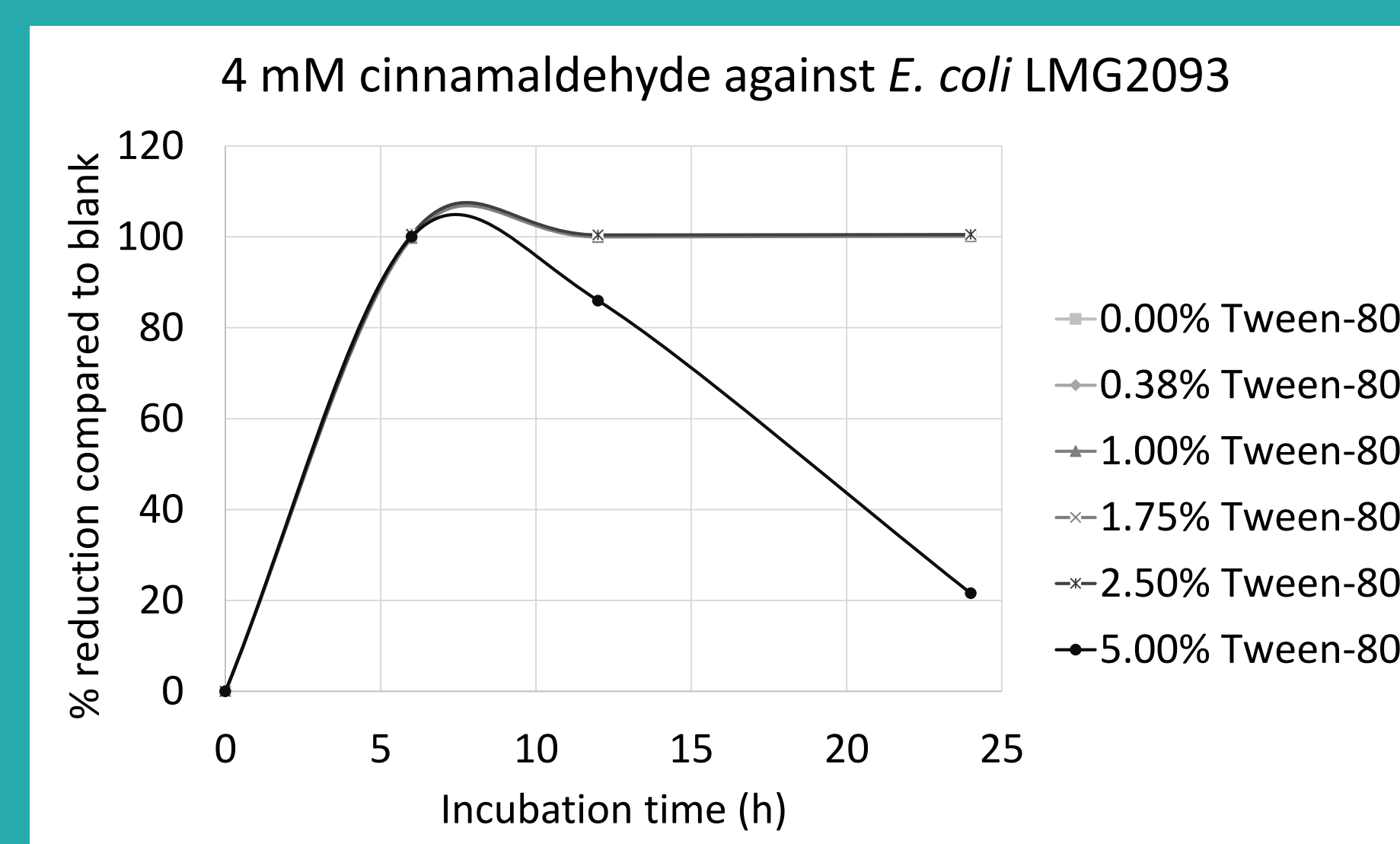
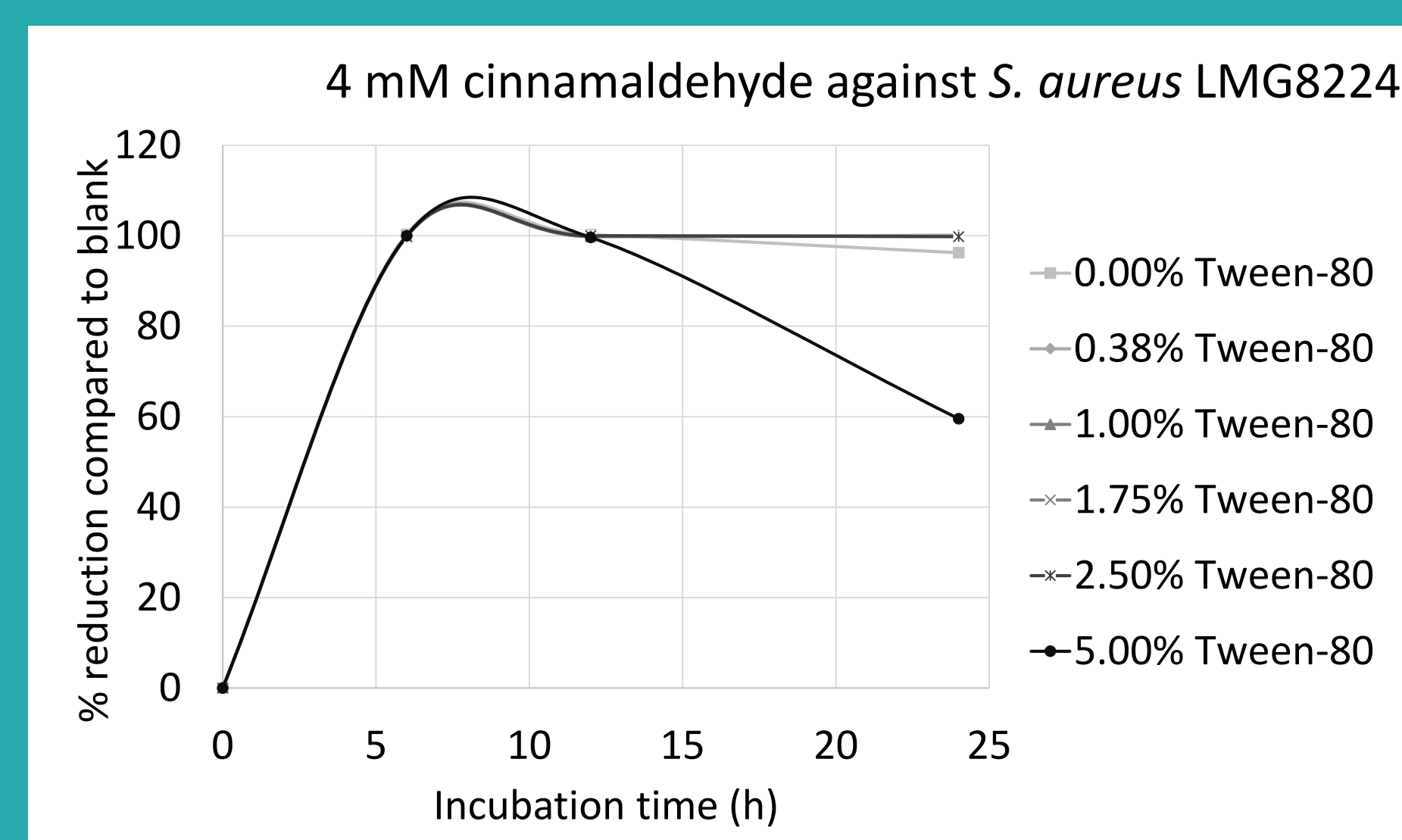
Measurement:

OD₆₂₀



*Results not shown

Results:



Partitioning of the EO compounds between the aqueous phase and micelles: diffusion NMR (H2)

Set-up:

Mixture preparation

1' vortex (max. speed)

Diffusion NMR



Calculations:

$$D_{\text{compound in mixture}} = x \cdot D_{\text{Tween-80 in mixture}} + (1-x) D_{\text{free compound}}$$

Results:

$C_{\text{Tween-80}}$ (% v/v)	Geraniol		Citral	
	Associated with Tween-80 (%)	Dissolved concentration (mM)	Associated with Tween-80 (%)	Dissolved concentration (mM)
0.38	70	2.4	68	2.6
1.00	80	1.6	77	1.8
5.00	92	0.6	90	0.8

Conclusions

- H1:** No clear link between the droplet size of EO compound emulsions and their antimicrobial activity could be observed.
- H2:** The aqueous concentration of EO compounds in emulsions decreased with higher Tween-80 concentrations, as did the antimicrobial activity.

References

Van de Vel, E.; Sampers, I.; Raes, K. (2017). A review on influencing factors on the minimum inhibitory concentration of essential oils. Crit. Rev. Food Sci. Nutr., 0; Taylor & Francis. Retrieved from <https://doi.org/10.1080/10408398.2017.1371112>
Wishart, D. S.; Jewison, T.; Guo, A. C.; Wilson, M.; Knox, C.; Liu, Y.; Djoumbou, Y.; et al. (2013). HMDB 3.0- The Human Metabolome Database in 2013. Nucleic Acids Res., 41: 801-807.

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